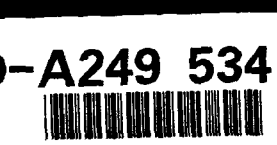

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY Unclassified	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release. Distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION US ARMY WAR COLLEGE 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) ROOT HALL, BUILDING 122 CARLISLE, PA 17013-5050	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification) Implications of The Third Industrial Revolution on the Elements of National Power and Their Impact on National Security Strategy -- Unclassified

12. PERSONAL AUTHOR(S)
LTC MELVIN L. HERITAGE

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Study Project	FROM _____ TO _____	16 March 1992	30

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL [illegible]	22b. TELEPHONE (Include Area Code) 717-245-3207 / 22c. OFFICE SYMBOL AWCAB

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

USAWC MILITARY STUDIES PROGRAM PAPER

IMPLICATIONS OF THE THIRD INDUSTRIAL REVOLUTION ON THE ELEMENTS OF NATIONAL POWER AND THEIR IMPACT ON NATIONAL SECURITY STRATEGY

AN INDIVIDUAL STUDY PROJECT

by

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ABSTRACT

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TITLE: Implications of The Third Industrial Revolution on the Elements of National Power and Their Impact on National Security Strategy

FORMAT: Individual Study Project

DATE: 16 March 1992 PAGES: 30 CLASSIFICATION: Unclassified

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IMPLICATIONS OF THE THIRD INDUSTRIAL REVOLUTION ON THE ELEMENTS OF NATIONAL POWER AND THEIR IMPACT ON NATIONAL SECURITY STRATEGY

INTRODUCTION

We are on the verge of a technological crisis. Ironically, we currently enjoy technological superiority in the world, yet our elements of national power have been eroding quietly for some time due to emerging technological trends we have failed to anticipate, quickly recognize, or adequately understand. These implications of the Third Industrial Revolution (the high technology revolution), if unchecked, will undermine our ability to create a viable national security strategy and to exercise world leadership. While we are basking in past glories, we could be losing our superpower status by default.

How has this situation happened? Part of the answer may be in the changing nature of industrial revolution. Another part of the answer may be in the new and varied ways that technological change has been affecting national power. Lastly, while we are familiar with many symptoms of this change, we have been slow to piece them together in an overall, coherent, "big picture."

THE THREE INDUSTRIAL REVOLUTIONS

In the contemporary literature there is a recognition that

mankind has experienced three periods of fundamental change that have substantially altered human productivity. The First Industrial Revolution was what most of us learned as "The Industrial Revolution," which was the period of massive change based on coal and the development of iron and steel manufacturing, railways, and consumer goods industries, beginning in England in the eighteenth century and then spreading to the Continent. This was the origin of the modern industrial city and fueled the growth of large urban populations. The Second Industrial Revolution occurred in the late nineteenth century and continued into the early twentieth century (approximately 1870s to World War I). It was based on oil and electricity, and was basically the age of the industrial tycoon and of invention. It was the time of diversification of industry characterized by the rise of organic chemistry and the commercialization of electricity, rubber, automobiles, airplanes, etc., and was identified with such names as Edison, Ford, Firestone, and the Wright brothers.

The Third Industrial Revolution is a term that has been equated to the explosion of "high technology" in the 1970s, 1980s and 1990s. What exactly is covered by "high technology" is variable depending on which author one reads. Biotechnology, materials science, semiconductor technology, lasers, and "big science" are some of the areas frequently mentioned, but it is the area of information technology that seems to be prominent on everyone's list. Information technology is not only a "high

technology" area in its own right, but it is also the enabling force for focusing and multiplying man's intellectual creative capacity for all areas of technological growth. Information technology can therefore be referred to as the basis of the Third Industrial Revolution. Referred to variously as the Information Revolution or the Information Age, it typically includes computer processors, storage technology, display technology, communications, and information-handling logic (software). Interestingly, news broadcasting and business telecommunications (FAX, etc.) are often lumped in with computer networking and telecommunications as a part of the Information Revolution.

There is a key relationship among these revolutions dealing with time, tempo, and the growth of knowledge. The First Industrial Revolution occurred after many thousands of years of activity by civilized man. The Second Industrial Revolution occurred over a hundred years after the First Industrial Revolution, and the Third Industrial Revolution occurred a few decades after the Second Industrial Revolution. The time between industrial revolutions is shortening and the level of sophistication is increasing. This is often depicted as an exponential growth curve of human knowledge.

This exponential curve is the result of the synergy achieved by the geometric growth of the human population coupled with the increasing body of knowledge carried forward through time.[1] Stated another way, change is increasing in speed and sophistication, fueled by the momentum of a growing population

adding collectively its insights and discoveries to the human knowledge base.

An important implication of this phenomenon is that since frequent significant technological change now occurs within the individual person's working lifespan, life-long education is a necessity to remain competitive in society.[2] Likewise, maintaining a technological edge is growing more demanding as continuous study is necessary to keep up with new developments, and as the volume, complexity and speed of information to keep up with increases exponentially.

INFLUENCES OR TRENDS INITIATED BY THE THIRD INDUSTRIAL REVOLUTION

The phenomenal increase in speed and in raw power of computer processors, the shrinking size and cost of basic computing systems, the continuing significant advances in display technology capability and quality, the rapidly increasing capacity and speed of information storage devices, the increasing sophistication of information handling and interpretation software, the growing explosion of communications connectivity (networking, satellite relay, etc.), as well as the increasing speed in conducting communications, and the amazing growth of information media options have literally transformed the developed world.

Whether or not one agrees with Marshal McLuhan's assertion that a "global village" has been created, certain impacts are

undeniable: A) Instantaneous communications are possible and common practically to and from anywhere in the world; B) Substantial computing power is common in the offices and homes of the general population; C) Information storage technology has made possible massive information libraries at the fingertips of private individuals and corporations; and D) Information-handling software has been developed that makes possible the manipulation and interpretation of large information data bases, to include the creation (through artificial intelligence or through visualization [graphical representation of data] for example) of new insights that would not be possible by manual means. Indeed, developed society today depends on these capabilities and demands their continued growth and evolution.

There are, however, a number of worrisome developments as well. There are questions of whether individual privacy has been destroyed by the growth in information technology. Likewise, the protection or denial of information to competitors is ever more difficult.

Information overload has become a problem decision-makers must contend with. Decision-makers often wrestle with information-rich situations for which they either don't have enough time or don't have adequate discriminators to allow them to make a reasoned decision.

Technology advances are becoming increasingly expensive and difficult to finance alone. This has led to partnership or consortium development to share cost risks, but these are hard to

form in a competitive world.

Also, production costs have continued to grow, causing the flight of basic manufacturing capabilities from the United States to overseas. Typically, the manufacture of production units (disk drives, monitors, computers) and components (integrated circuit chips and other semiconductor devices, for example) for high tech systems are made in Pacific Rim countries (mainly Japan, Korea, Taiwan, Singapore, and Malaysia) where production costs (usually labor) are lower.

Additionally, questions are being raised about whether we are losing our technological edge to foreign competitors. For example, in the area of university engineering education, the total number of degrees awarded in the United States each year to non-U.S. nationals has been growing to such an extent that they account for almost 50 percent of engineering degrees awarded in the United States at the baccalaureate and graduate levels, bringing into question whether the United States will continue to have the educated labor pool to sustain research and development leadership.[3] This is not a case of universities favoring foreign student admissions; rather, it is a reflection of deep-seated trends within this country.

A recent comparison of elementary and junior high school students internationally shows the U.S. lagging behind world average performance levels in science and math, with the biggest gap occurring with the older U.S.students and their bottom 20 percent ranking among the 15 countries that were compared.[4]

This is a problem further perpetuated by the fact that only 16 percent of American high school students study math and science beyond tenth grade, and by graduation 75 percent do not have the prerequisites to enter a college science program.[5] American universities thus find themselves needing foreign students to fill technical-program enrollments and to get adequate numbers of teaching and research students, since programs that fail to do this must close due to cost considerations. While it is true that many foreign students stay for a while in this country after graduation for teaching and industrial opportunities, the bottom line is that the domestic technical talent pool is shrinking drastically and dependence on foreign talent is increasing to significant levels.

The technological edge is therefore in the process of shifting from this country to other countries. A reflection of this shift is evident in the U.S. patent trends. Patents in the United States are increasingly being awarded to foreigners--43 percent in 1985.[6] This grew to approximately 53 percent by 1988. Similarly, during the same period the ratio of Japanese-originated U.S. patents to U.S.-originated U.S. patents had grown from approximately 0.45 to approximately 0.71.[7] In fact, The New York Times recently observed that "in 1990, the top holders of United States patents were all Japanese companies--Hitachi with 908, Toshiba with 891, Canon with 868 and Mitsubishi with 862. General Electric, which once dominated the top spot, ranked fifth with 785 patents."[8]

And finally, questions are being asked with respect to the Third World as to whether the Information Age doesn't in fact represent a new age of exploitation by the more developed world of the lesser developed world.[9] There are definite limitations as to how much technology a Third World country can absorb quickly. Meanwhile, the more advanced world is accelerating in its technological growth, widening the technological and economic gap with the Third World. The balance of trade favors the more advanced world because of the differences in cost in more intellectually intensive products versus the raw materials of nature (with notable exceptions such as oil). This understandably raises deep frustrations in those lesser developed countries.

The world economy is becoming increasingly globalized as characterized by the spread of multinational corporations. While multinational corporations have been with us for quite some time (e.g., ITT was a multinational corporation well before World War II), the trend has accelerated with the advent of the Third Industrial Revolution. This is in part due to the need for survival against the ups and downs of the economy in any one country, but it is also in response to the shifts in location of profitable manufacturing sites, the need for ever-increasing sums of money for the skyrocketing cost of technology development, and the realization that a company needs to have branches located with its markets in order to develop those markets. The very nature of multinationality of corporations, however, sometimes

raises questions as to which nation's sovereignty the corporation ultimately relates to.

Related to the multinational corporation issue is an insight recently reported in Newsweek as to the nature of new acquisitions by the Japanese in this country. The current trend of Japanese industrialists is to buy small high-tech companies. We have a lot of innovative small companies that need cash to fuel that innovation, but venture capital is tight in this country at present. The Japanese have lots of cash and are eager to add to their technology base for their long term competitive position. In fact, "since 1988 272 U.S. high technology companies have been purchased outright or have received investments from Japanese firms."[10]

Increasingly, it has been noted, the proliferation of electronic financial networks has enabled the "essentially free and uncontrolled flow of investors' capital across national borders."[11] Governments thus learn of shifts in financial landscape after the fact, if at all.

Another trend is the creation of a global culture. The increased speed and ease of personal travel, combined with electronic windows on the world, real-time awareness of events around the world, and coupled with extensive world trade have fostered a cosmopolitan outlook and common experience base for a rapidly increasing proportion of the world's population. A "collective mode of life" with "a repertoire of beliefs, styles, values, and symbols" is emerging that is "eroding the power of

the nation-state."[12]

RELATIONSHIP TO THE ELEMENTS OF NATIONAL POWER

The Army War College currently teaches national power as having three principal components: political, economic, and military. The impact of the Third Industrial Revolution on these elements of power has been significant.

Several authors have noted the impact of instantaneous broadcasts and of the electronic exchange of data through networks and other communications means. The live broadcasts from Baghdad under attack, the scenes of protest in Tiananmen Square where demonstrators carried signs written in English to get the attention of world audiences, the French satellite photo coverage of the disaster at Chernobyl while Soviet officials denied there was an accident, the daily monitoring of stock market prices all over the world via computer networking, and the exchange of technical data among research scientists via computer networking and FAX are all examples of the power and role of communications. These are capabilities we have come to expect in a free society. But, they are also indications of the sharing of power that not too long ago by intent or default was the province of government alone.[13]

The increasing availability of information to the public and the ability to communicate it quickly are placing growing limitations on the ability of a state to exercise political

power.[14] This is not necessarily bad, as it fits in with our fundamental philosophy of an informed public being a check on the tyrannical tendencies of strong centralized government. There is, however, the danger of flashy phrases and emotional button pushing that instant communications brings, raising concerns of at least one observer as to whether good decisions still result from this short-circuiting of a more deliberate and exhaustive evaluation process.[15]

With respect to economic power, Walter Wriston has suggested that sovereignty of states has been undercut by what he calls the Information Standard.[16] Whereas nations previously set the value of their currency themselves by backing it with gold or other negotiated means, now the international market sets it in response to continuously received data on computer networks, creating in effect an international monetary standard based on information. This, combined with the fact noted earlier concerning the free flow of capital across borders over electronic financial networks, brings into question the degree of control a nation really has over its own monetary policy and fiscal situation. Money may even be the wrong focus today, for as Brandin and Harrison observe, suggestions are beginning to be made that the true form of wealth may have changed, in that knowledge itself may be developing as the new measure of wealth in comparing the economies of nations.[17]

There are other more traditional impacts to economic power which have been alluded to earlier in this paper. The facts that

the high-tech manufacturing base has been slipping overseas, that Americans have a low savings rate and thus do not have capital for investment in infrastructure and research and development, that America is training its economic competitors in its schools (even though they are political allies), and that we do not have a co-ordinated, unified economic policy are all signs of trouble to come.[18]

Admiral Bobby Inman, the former head of SEMATECH, points out that the economic policymaking machinery on technology matters is broken. He states that responsibility for economic policymaking is currently dispersed among too many agencies and that we need one agency in charge of strategic co-ordination of economic policy at the national level.[19] (This same assertion can be made for many policy areas for which our government is responsible, e.g., the current dilution of responsibility of policymaking in the drug enforcement area among numerous departments, such as Justice, Treasury, State, etc.) When a policy area gets "hot" because of this dilution, the normal response in the past has been to make a big show of creating a "czar" to pass the problem to, but without following through on the fundamental reform and the policy enforcement "teeth" to allow him to succeed rather than just become another part of the problem. While it can be questioned whether we need another czar to fight the bureaucracy, the fact that everyone (and therefore no one) is in charge raises doubts as to whether a less extreme tactic will turn around the current stalemate.

Japan, in fact, has long enjoyed the advantage of a centralized agency to co-ordinate economic policymaking in research and development, education, and trade. The Ministry of International Trade and Industry (MITI) plays the principal role in co-ordinating domestic commercial research and development to preclude wasteful duplication, in encouraging consortia of industry to co-operate and share in pre-competitive development, in sponsoring research and development where necessary (e.g. Fifth Generation Computer Systems), in co-ordinating education policy with technological needs, and in assisting and protecting domestic industries in international trade endeavors. MITI has a very activist outlook that has in no small measure enabled Japanese industry, indeed Japan as a country, to be exceptionally competitive and successful in its balance of trade.

Our economic relationships with the Third World now require an awareness of how information technology and other Third Industrial Revolution technologies affect those relationships. Complexity has been added through the inequalities in power brought by the centralizing tendencies of information management coupled with the instancy of modern communications, emphasizing even more the dominant versus the subservient roles of the relationship.[20] Coupled with the widening economic gulf between the developed world and the developing world, the question must be asked at what point this unequal relationship turns to alienation. A real challenge is before us as to how technology and economic power are best used and in managing their

implications in other areas (political and military) of national security strategy.[21]

The picture in the military power element is equally complicated and discouraging. Key in our doctrine of warfighting is the necessity to go through our decision-making cycle faster than the enemy can go through his. To achieve this on today's battlefield has required employing automation. This, in turn, has left us hostage to an economic consideration noted earlier, that of a foreign manufacturing base. When one considers that most of the integrated circuits, displays, storage devices, and numerous other critical components are only available from overseas sources, it is obvious how vulnerable the exercise of military power can be if piece parts or assemblies from those sources are cut off. In fact, Snow argues that military power may not even be relevant anymore for achieving some national interests.[22]

The rising cost of military systems is also affecting the use of military power. Fifty years ago systems were simpler and cheaper but not as capable; nonetheless, quantities then were usually in thousands. Rising costs in materials, labor, and technology, along with shrinking budgets that force uneconomical production run sizes (and thus higher per-unit costs) today force major acquisitions to be limited often to quantities in dozens. Fewer systems means fewer units get equipped, and therefore a smaller size force that can be fielded operationally with that capability. This forces more attention on extending the life of

already existing systems in the field through the use of modest improvements which provide a system improvement in capability or a reduction in life cycle costs on a favorable cost-benefit ratio. This provides a good method of near-term fixes, but only defers the costs for significant improvement or whole system replacement that will eventually be necessary as threat capabilities advance or as systems irretrievably age beyond utility.

A compromise approach that has recently been suggested is to do research and development of new technology (to include proving it in a prototype) and then put it on the shelf until production dollars become available. This sounds good on the surface, but has a lot of problems with it. First, this only works where one has early warning of a crisis, for it takes a long time to get a contractor on board and cranked up to run a production line. For a big system this can be a year or more. What drives this lag are the procurement regulations on timelines and procedures on letting a contract of any substantial dollar value, the long lead procurement time of piece parts and materials (connectors, semiconductor devices, and other components that must meet necessary performance specifications), as well as any update the design may require due to technology changes or threat changes in the time the design has been sitting on the shelf. Additionally, major funding (above reprogramming thresholds) that may be required will take two years to obtain due to the government budgeting cycle and will further delay the start of contract.

Even if these problems are ignored, what we will see is the escalation of research and development costs for projects because the government will be forced to bear the full cost and contractors willing to do government work will seek to minimize their financial risk. (What has typically happened in the past is that contractors have sacrificed profit or even borne part of the costs as a corporate investment on the expectation of making it up on a production-contract win.) This escalation of costs will limit the number of research and development efforts the military can afford (or at least their size). There have been instances where a contractor has been asked to bear the entire cost of research and development, but this only works for the winning contractor, and only then when there is an immediate production-contract award with an adequate profit margin to make up research and development costs.

The result of this situation is a shrinking industrial base and an increasingly inadequate picture for "equipping the force." All the way around the constraints in today's economic environment and government military budget situation are increasingly limiting options in maintaining a credible military element of power.

There are indirect influences from the Third Industrial Revolution that have complex and interacting effects on our national power. For example, Japan has been one of the main beneficiaries of the economics of high technology. Japan has been particularly astute with respect to developing its

manufacturing base, and in building cash reserves due to a national savings ethic and an extremely favorable balance of trade situation. While Japan is an ally, it has further profited at the expense of our economic power. Japan spends a very small fraction of its GNP on defense because American military power continues to protect the North Pacific rim. While there are many reasons (fear of resurgence of Japanese militarism, for example) why the situation persists, this contradiction in effects on our national power has worried a number of knowledgeable observers and confused our population at home.[23]

IMPLICATIONS FOR THE FUTURE

The future is getting both harder and easier to predict from a technological standpoint. On the one hand, it is extremely difficult to figure out where the next breakthrough is going to be; on the other hand, technology advance seems limited only by imagination and therefore is an event of certainty in most areas. Technology will continue to advance, and we must advance with it if we and our elements of national power are to remain competitive.

Several realities have emerged concerning national power from a technological standpoint. It is clear that the exercise of national power is going to be a "damned if you do, damned if you don't" proposition in that its exercise will likely have both advantages and drawbacks to every option because of the inter-

relationships and often contradictory implications of technology on all three elements of national power.

Sovereign power will continue to diminish. Interdependence among nations will continue to grow in an increasingly multi-polar world, limiting our ability for independent action. Consensus building will be an ever more important and difficult task. With the enormous availability of raw and processed information, and with the volatility of passions that can be fanned by instantaneous communications, building a domestic consensus for political action will be an ever slowing and daunting task. It will be increasingly difficult to retain consensus. With interdependence increasing among nations, building and holding together an international consensus for political, economic, and military power balance among nations will become even more critical if peace is to be maintained. Unfortunately, it will be born in the same agony as domestic consensus building for the same reasons.

We are at a serious disadvantage in today's world with multiple agencies having responsibility for economic policy. If we are to be competitive now and retain our competitive edge for the future, if our trading partners are to have a clear understanding of what the rules are when they enter a deal with us and have confidence that the rules won't change mid-stream, if we are to approach economic relationships with Third World countries with an awareness of the sensitivities of those relationships and with a framework that is mutually beneficial,

then our country must be seen by the world as having one economic policy which balances all of these concerns, instead of numerous contradictory policies born from competing bureaucratic interests. Otherwise, our economic element of power will continue to decline.

This is not to say that we should turn this country into a "Japan, Inc." using the MITI model. We have, after all, a pluralistic society that has been admired around the world because of the ability of all points of view to be heard, and this philosophy has been embedded in our form of government. We will still need to have advocates for the varying points of view of what is good economic policy and go through the consensus building process to come up with the best overall policy that constraints will allow.

We must, however, be able to come to closure with <u>one</u> policy that is recognized around the world by our trading partners as our national policy and be able to effectively implement it. This requires that one agency must be in charge of co-ordinating the various other agency views and then make the hard decisions when called for. If we are to be successful in achieving our national security objectives in the long run, we must ensure that our country is co-ordinated in formulating and in executing technological policy, or else we will be perceived by the international community as having no policy at all.

Co-operative development is going to become even more important. We won't have a monopoly on brainpower in all

technical areas, and we won't have the money to fund all the development and production we need. Our friends will have the same problems, but if they have the brainpower in areas that complement ours and have enough additional money to be combined with ours, then we can both achieve our common ends together. At the same time, we will have to carefully scrutinize the corporations we do business with as to where their interests lie in an increasingly multinational environment and in how those interests intersect with our national interests.

Our technological edge is quickly going down the drain. We are training fewer and fewer of our citizens in our own engineering schools. We are suffering an erosion of the quality of our schools both from a quality of teaching and from a quality of resources standpoint. Fewer and fewer of our own innovations really belong to us (as evidenced by the patent situation). We are investing too little in research and in our manufacturing base to capitalize on the innovations we do come up with. High-tech research is becoming increasingly expensive, because it is brainpower intensive, and adequate money is becoming increasingly hard to obtain. This situation is directly impacting on all three elements of national power--economic, political, and military--although a lack of public awareness of the extent of this impact coupled with over-confidence in the superiority and permanence of our technical capabilities veils the seriousness and immediacy of this near-term crisis.

We need to take a careful assessment of our dependence on

foreign sources of manufacturing to ascertain how much risk we are prepared to take. We cannot allow ourselves to be hostage to foreign control on resupply sources for technological items.

We need to pay more attention to what industrial base we still have. Market pressures have already driven many critical manufacturing capabilities overseas and many more are on the brink of doing the same. A sagging technological development posture is in evidence here as noted above in education, facilities, and funding. Coupled with poor government acquisition approaches, the number of industries here that will be able or willing to engage in government contract work will continue to decline unless action is taken to reverse or at least stabilize the situation. This will require a comprehensive approach that covers the entire range of system life cycle activities.

Technology itself is going to be a source of conflict because of its influence on national power. Third World countries aspiring to be regional powers through force will buy, steal, or get assistance in developing advanced weapons from any source they can. With the current economic and political instability in the former Soviet Union, the very real possibility exists of technological experts being "hired" and relocating to aggressive Third World countries, or even the sales of advanced weaponry or key components to them in exchange for hard currency or priority barter items. Even where regional dominance is not the issue, but rather where genuine concern for the declining

standard of living (or perhaps even survival) for one's country exists, the growing gap between "have" and "have not" nations and the resulting frustrations and frictions will, in itself, contribute to sparking conflict.

As has been shown, the impact of "high technology" (the Third Industrial Revolution) on the elements of national power is significant. Technology can both strengthen and weaken all three elements of national power collectively and individually. Our status as a superpower depends on maintaining elements of national power at a level of unquestioned superiority, yet, as has been shown, we are in danger of losing that superiority. The key question is whether our national security strategy recognizes the fragility of national power and takes steps to ensure that technology does not undermine our means to achieve our policy ends.

IS OUR NATIONAL SECURITY STRATEGY ADEQUATE?

The national security strategy of the United States is recorded in an annual document required by the Goldwater-Nichols Department of Defense Reorganization Act of 1986. While there had been a national security strategy before that time, Congress felt it was too fluid and uncertain and required its capture in an official form in print.

With respect to the political element of power, the National Security Strategy recognizes the essential role of collective

"collective mode of life" with "a repertoire of beliefs, styles, values, and symbols" is emerging that is "eroding the power of

action in achieving our objectives, and the need to get more involved in the increasing dialog that social change and advanced technical capability have brought. It also recognizes that collective action will be required in a variety of roles, to include foreign assistance action and control over proliferation of advanced weaponry. Additionally, it recognizes that intelligence activity (an activity dependent on technology) will continue to be important for us to be informed on the world social, political, economic, military, and technological dynamics, in order to ensure that the political element of national power is effectively used.

With respect to the economic element of power, the National Security Strategy starts out well by recognizing that our economic policy must be managed within the context of global economic conditions. Unfortunately, the need to improve our economic policymaking machinery by having only one agency in charge has not been recognized. While the National Security Strategy does recognize the need to encourage private savings and investment to improve competitiveness, as well as the need to do a better job improving trade opportunities for domestic technology companies on the international market, nothing is said about co-operative development, restoring the manufacturing infrastructure, and maintaining our technological edge through education programs and research facilities.

Interestingly, the National Security Strategy recognizes that our technological edge is important to the military element

of power. It also recognizes that this edge will be more difficult to maintain in the future as the defense industry shrinks and as advanced weaponry finds its way into the hands of potential adversaries. While advocating pursuing "high-leverage" research, it also declares that weapons must be less expensive, which of course is contrary to current trends. (This also assumes we have the technological edge and facilities in the future to support such research.) While emphasizing technology development, the National Security Strategy somehow expects limited production and rapid fielding even though it has not addressed how it will ensure that a defense industry will still continue to exist given declining defense budgets. The key clues to the desperateness of the situation are the statements that "we will ... have to plan for production from new or alternative industrial capacity" and that we need "to involve the creative resources of our national economy."[24] In other words, we don't have an answer, so we are open to suggestions.

CONCLUSIONS

The world political, economic, and military situation has practically turned upside down since the National Security Strategy was written (August 1991). But, from a technological viewpoint, the document was then, and continues to be, flawed. While recognizing the important role high technology plays in political, economic, and military power, it has been overly

simplistic as to what it takes to develop high technology and is naive as to how high technology is incorporated into an effective form that can then be applied as a part of each element of national power. As a result, it fails to take the steps necessary to ensure that technology is able to work for us rather than against us.

Certainly action is needed in maintaining the technology edge we currently enjoy by putting positive programs in place for improving the quality and stature of technical education, in creating and promoting more and better developed and co-ordinated research facilities, and in attracting more and better students to the study of engineering/technology. This can be facilitated by acting on the major omission of the strategy document, which is to place a single agency in charge of co-ordinating and formulating economic policy--one which understands and acts on the complex inter-relationships of technology to all facets of our society. It is through the single policymaker focus that problems in manufacturing base loss, defense industry decline, third world relations on technology, technical education policy, and other technology-related areas can begin to be addressed in a co-ordinated and effective manner. Unless we turn these problem areas around, how can we expect to be able to have the economic or military strength or the political standing necessary to protect our interests?

While it is not the purpose of the National Security Strategy to provide specific solutions, it must provide the

strategic concepts through which the national objectives this country has are to be achieved, with the resources we have available. Certainly, with respect to the technology viewpoint, the strategy can and must be improved.

ENDNOTES

1. I. M. Hymes, "The Revolution in Manufacturing," in Windows On A New World: The Third Industrial Revolution, ed. Joseph Finkelstein (New York: Greenwood Press, 1989), 173.

2. Ibid., 173-176.

3. Katherine T. Chen, "Education: Trouble Waiting in the Wings," IEEE Spectrum 26 (November 1989): 63.

4. Mary Jordan, "Students Test Below Average," The New York Times, 6 February 1992, A1 and A4.

5. David H. Brandin and Michael A. Harrison, The Technology War: A Case for Competitiveness (New York: John Wiley & Sons, 1987), 90.

6. Ibid., 90.

7. Trudy E. Bell, "Just Keeping Current Entails Ingenuity, Resourcefulness, and Improvisation," IEEE Spectrum 27 (October 1989): 70. This is an extrapolation of the graphic data shown in the article.

8. William J. Broad, "Pentagon Wizards of Technology Eye Wider Civilian Role," The New York Times, 22 October 1991, C1 and C11.

9. Andrew Gillespie and Kevin Robins, "Geographical Inequalities: The Spatial Bias of the New Communications Technologies," Journal of Communication 39 (Summer 1989): 13-14.

10. Bill Powell, Jeanne Gordon, Debra Rosenberg, and Rich Thomas, "What Will Japan Buy Next," Newsweek, 11 November 1991, 49.

11. Andrew S. Targowski, "Strategies and Architecture of the Electronic Global Village," The Information Society 7 (1990): 201.

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13. Kenneth H. Keller, "Science and Technology," Foreign Affairs 69 (Fall 1990): 130-131.

14. Walter B. Wriston, "Technology and Sovereignty," Foreign Affairs 68 (Winter 1988/89): 67.

15. Ibid., 68.

16. Ibid., 71.

17. Brandin and Harrison, 7.

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19. Ibid., 129-130.

20. Gillespie and Robins, 13-16.

21. Lawrence Eagleburger, High Technology and American Foreign Policy (Washington, D.C.: American Enterprise Institute, 1985), 17.

22. Donald M. Snow, "High Technology and National Security: A Preliminary Assessment," Armed Forces & Society 17 (Winter 1991): 255.

23. Eagleburger, 16.

24. George Bush, National Security Strategy of the United States, August 1991, 31.

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